Nutrient Science Advisers
June 26, 2007

The meeting started at 10:00 in room 240, Bessey Hall, Iowa State University

Participants included: Mike Burkart (ISU), Mike Birmingham (UHL), Pete Weyer (UI), John Downing (ISU), Joe Larsheid (DNR), Gary Welker (EPA), John Olson (DNR), Chris Jones (DMWW), Tom Wilton (DNR), Bill Ehm (DNR) Observers included: Adam Schneiders (DNR), Connie Dou (DNR), and Chuck Corell (DNR).

Discussion about Transparency as measured by Secchi Depth
It was generally agreed that the weight of evidence justifies a transparency criteria of at minimum 1.0 m.
– A natural break point in plotting secchi depth and Chl-a occurs at depth of 1.0 or 1.2 m and Chl-a of 27.5. Joe Larsheid agreed to provide a statement to this effect referencing a graph.
– Carlson's Trophic State Index (TSI) defines eutrophy as equivalent to 1- 2 m transparency and depths less than 1.0 m as hypereutrophic. (Muhammed Iqbal cited a link to this information-- http://dipin.kent.edu/tsi.htm).
– A depth of 1.0 m coincides with adult waist depth considered a minimum to avoid a visible hazard.
– The Boy Scouts of America recommend 3 ft or approximately 1 m. A specific reference will be needed for this?
– Incidents of accidents and drowning related to visibility may not be specifically quantifiable. Pete Weyer and Tom Wilton agreed and Ed Bottei will be asked to find citable data from the Iowa Health Dept. and published reports.
– Minnesota lake report cites1.2 m criteria from Ontario. John Olson agreed to find the original paper/report and draft a statement.
– Visibility of greater than 1.0 m corresponds to E. coli of less than 100 c/ml measured in lake centers. John Downing's agreed to prepare a graph and interpretation to support this conclusion.
– Tom Wilton agreed to find the WHO lake turbidity guideline.
– Iowa Public perception survey supports 1.0 or larger. Mike Burkart will contact Cathy Kling and Joe Herriges to get raw data and John Downing will redraw graph relating EPA water quality ladder ranking to secchi depth to provide more specific depth values.

Discussions about the relationships between secchi depth (SD) and TP included:
– SD < 1.0 m occurs when TP > 90 µg/L in MN Lakes (Heiskary, 2005)
– Based on data from Iowa lakes, John Downing will correlate and we will agree upon either a natural break point and/or use probability/risk analysis to define the frequency of TP concentrsation that will coprise the criteria.
It was pointed out that Criteria components need to include concentration, duration and frequency. There was a consensus that frequency would be provided using a "probability of occurrence" concept as a risk measure. This seemed appropriate for EPA according to Gary Welker. John Downing will talk to Mark Kaiser (Stat. Dept.) about how, in general, to extract duration from a frequency distribution.

Discussion about Chlorophyl-*a* included:
A potential for a consensus concentration in the range of 20 to 30 µg/L Chl-*a* concentration using the weight of multiple lines of evidence.
Evidence includes:
– Carlson's Trophic State Index (TSI) defines eutrophic conditions equivalent to 7.3-20 µg/L Chl-*a* and greater than 20 µg/L Chl-*a* as hypereutrophic (Muhammed Iqbal, http://dipin.kent.edu/tsi.htm).

– Florida found the concentrations of algal blooms to be 40 µg/L Chl-*a*. This will be a concentration we definitely want to avoid. Mike Burkart will check his references to determine if this is the mean or median.
– Mike pointed out that 30 µg/L is considered to be a nuisance and he will check the reference for qualifications on this value.
– Mike also pointed out that in Minnesota, blooms can occur when TP exceeds 30 µg/L Chl-*a* and at 100 µg/L TP, the probability of blooms exceeds 70% (Heiskary and Wilson, 2005).
– Joe Larsheid presented graph showing a natural break point at about 27 (?) µg/L Chl-*a* when plotted against TP and Secchi depth. Joe Larsheid agreed to describe this further with references.
– John Downing agreed to graph the probability of Chl-a exceeding 10, 20, and 30 µg/L for discussion.
– John Olson agreed to pursue possible swimming or health hazard concentrations.
– Chl-a concentrations need to be related to TP and TN in Iowa lakes once we come to consensus about a concentration.

Discussions about Cyanobacteria included:
A consensus was that Cyanobacteria may not be a useful variable to use for nutrient criteria unless an explicit human health hazard such as toxicity to microsystins upon contact or ingestion could be found.
– Pete Weyer will check literature and Mike Burkart will ask Ed Bottei to investigate further.
– It was pointed out that free toxins (extra-cellular) may be the primary form of toxins compared to those found within the living organisms. The toxicity of these compound within the organism may be toxic when ingested.
– Specific questions that were raised include:
What dose of extracellular microcystins is related to some health hazard (contact or ingested)?
How do microcistins inside the cyanobacteria affect human health?
– Microcystin toxicity equivalents 1.3 µg/L- Australia (Ed Bottei) . How does this relate to toxicity upon ingestion or contact upon imersion? Ed Bottei has indicated to Mike that he will search his literature on these and other questions
– We still don't know specific WHO recommendations for Cyanobacteria or microcystin concentrations for recreational contact. John Olson will find value.
Some of the problems of using this as a variable:
– Cyanobacteria seem to be present in all Iowa lakes at some concentration.
– They frequently dominate (>50%) the phytoplankton biomass even when the total biomass is small (non-bloom status) making it difficult to use dominance as a criterion.
– Microcystin analyses are not commonly performed in labs commonly used by DNR

– Microcystin concentrations correlate with Cyanobacteria biomass with an r^2 of 0.30 (quick calculation by John Downing).
– AWWA DW standards are 15,000 cells/ml Cyanobacteria. What is the equivalent in microcystin concentrations? (Chris Jones)
– Microcystin 15 ppb considered a health hazard (Nebraska HHS, Ed Bottei)
– Eric O'Brien, DNR- water monitoring group was mentioned as an expert on Cyanobateria.

Phytoplankton biomass discussion:
We came to consensus that this would not be used as an independent variable because it is so closely related to Chl-a. Chl-a is a much more standard and readily measured variable. The discussion of Chl-a will include a justification based on it being a measure of phytoplankton biomass and consequently algal blooms.

Other possible variables discussed:

– Bacteria. E-coli, fecal colliform and campylobacter were discussed as possibly being related to nutrient concentrations.
– What is toxic level?
– How well do they survive in water?
– 85% die within 24 hours.
– They live longer in cold water when swimming is not as likely.
– May survive in sediment
– Chris Jones had some other comments about survival in DMWW lagoon. Can you include them?
– How are bacteria survival rates or concentrations related to nutrients? Pete Weyer was interested in pursuing this topic.
– Macrophytes, smell, surface scum and bottom texture were discounted as useful variables.

Aquatic Life Designated Use Discussions Incluided:
– Mike Birmingham and Joe Larshied agreed to examine historical papers and data, at least from Lakeside Lab.
– Joe Larsheid discussed the phenomenon of oscillation between a clear lake phase with healthy populations of macrophytes followed by a turbid phase when macrophytes were disturbed. The turbid stage usually takes a long time to switch back to a clear phase. Joe agreed to provide a better description of this phenomenon.
– Sediment cores were mentioned as a basis for defining pre-settlement. Mike Burkart indicated – Mike Burkart announced that Dick Baker, UI, had agreed to participate with the group to add his knowledge of aquatic organisms from sediment cores in lakes and streams. Mike Birmingham agreed to meet with Dick Baker to about the topic before the next meeting.
– Tom Wilton mentioned that there are a couple of other researchers.
Jay/Joy Ramsack (?) who has worked on diatoms in Minnesota lakes.
Paul Garrison, Wisconsin DNR.
– Chuck Corell mentioned studies done in Clear Lake and Silver Lake as well as Norm Sengem working on Lake Peppin.

Additional Topics

– John Olson will scan and download an old paper on West Okoboji.
– Chuck Corell mentioned that DNR treats COE reservoirs as rivers.
  – It was generally agreed to treat reservoirs as lakes until some clear differences emerge in studying aquatic life.

Discussion about Tiered Aquatic Criteria
Gary Welker presented some diagrams (Figs 7 and 8) representing Maine and Kansas approaches to "tiered" aquatic life uses. Figure 7 stimulated extensive discussion.
– Where do you draw the line for impairment?
– Mike Burkart suggested that a continuous series of aquatic assemblages may be definable ranging from natural through minimal loss of species; loss of a few species sensitive to contaminants (nutrients?); loss of all but a few sensitive species; to the totally degraded condition where only species tolerant of large nutrient concentrations survive (hypereutrophy?).
– Joe Larsheid suggested we could use macrophytes to develop the vertical axis. He mentioned the agae-macrophyte gradient as a mechanism for characterizing fisheries.
– What other organisms could be used to indicate "good" water quality for aquatic life?

– Others suggested similarly, fish and diatoms, for example, could be used as well to build Y axis subdivisions from assemblages, combinations of critical species, specifically those that would be lost due to high nutrient concentrations.
– To address the question of an "impaired" line, it might be able to develop a shaded zone, within which some degree of impairment could be initially be tolerated by a user community pending changes that would raise the quality closer to the natural state.

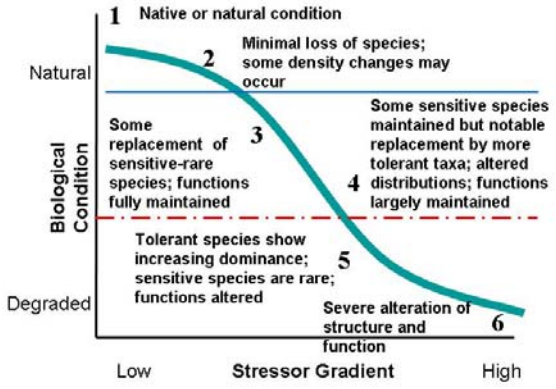

Figure 7. Tiered aquatic life uses.

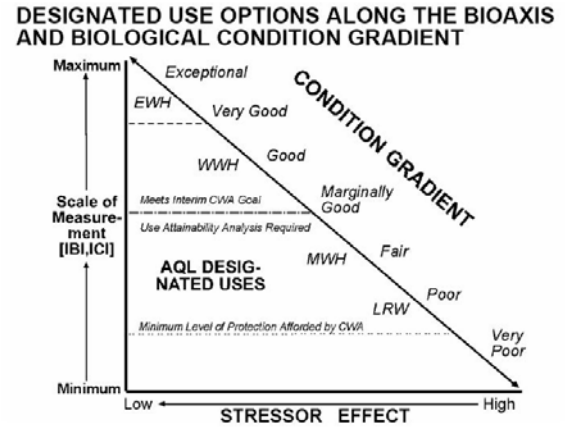

Figure 8. Condition Gradient example of tiered aquatic life uses.

The meeting ended at 4:00